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printed in two large volumes in 1887 and 1890, and constitute his most ambitious work.

Aside from his scientific work, Dr. Eggleston took a very active part in religious and charitable work. He was a vestryman of Trinity Church for twenty years, and at the time of his death was Junior Warden, as well as member of several committees. For nearly thirty years he was Vice-President of the Protestant Episcopal Mission Society and a Trustee of the General Theological Seminary. He is also to be credited with the establishment of 'Food Kitchens' in New York, and with organizing the Public Parks Association by which Washington Square was saved. The Audubon Monument movement was also started by him.

In 1874 Princeton conferred upon him the degree of Ph.D., and Trinity that of LL.D. In 1890 he was appointed a Chevalier of the Legion of Honor by the French government on the recommendation of the Director and members of the Faculty of the École des Mines. In 1895 he was made 'Officier.' It is pleasant to record also that since his death the Trustees of Columbia University have named the Museum of Mineralogy the 'Eggleston Mineralogical Museum,' thus attaching his name permanently to the collection which he created and loved.

In 1896 his health gave way, and though after a rest he endeavored to resume his work, he could not stand the strain and was retired June 30, 1897, at his own request, as Professor Emeritus.

The service of Dr. Eggleston to science lies not so much in his numerous writings, though these contain an enormous mass of valuable information collected with infinite labor and published always when and where they were needed. Far more important was what has been happily called 'his intuitive perception of the situation,' his recognition of when the time was ripe to

inaugurate a movement, his skill in organization and the amazing vigor, persistency and unfailing belief with which he forced it to success. ALFRED J. MOSES.

*THE SEVENTIETH BIRTHDAY OF CARL VON KUPFFER.—HIS LIFE AND WORKS.*

PROFESSOR VON KUPFFER has lately passed the mark of three score years and ten and has received the congratulations of his students of many lands. Some of these, following the good German custom, have prepared memoirs in his honor which appear in a memorial volume and were presented him as a birthday gift. Von Kupffer has been a most helpful friend to the Americans who have carried on their investigations in the Anatomical Institute in Munich during the past generation, and it seems but just that at this time an American journal should pay a tribute to his life and work.—EDITOR OF SCIENCE.

Carl von Kupffer ranks to-day as one who has taken a place within the innermost circle of comparative embryologists. He has long been recognized as a profound scholar in a broad field of zoological knowledge; he is best known, however, for his researches upon the structure, development and descent of the vertebrates.

In his biography von Kupffer presents an interesting parallel with the great embryologist, Karl Ernst von Baer. Both were natives of the Baltic provinces of Russia, students and graduates of the University of Dorpat, and sometime practicing physicians until drawn into zootomical-embryological research. Both were for a time professors at Königsberg, and showed a distinct bent towards the widely separate themes of Arctic exploration and craniology; they were equally interested in matters relating to fish and fishery and contributed important memoirs to this subject. On the other hand they had in general but little leaning towards work of the systematist.

Both left Königsberg for wider fields, von Baer, however, to largely lay aside his embryological researches, the other to extend and correlate his. An interesting difference between the two embryologists is this, that von Baer had completed his most important work when he was scarcely over forty years of age, while von Kupffer had not begun his best known work until he was over sixty. A further difference is that Kupffer has held fast to the early themes of his research. Von Baer lived until his eighty-sixth year; von Kupffer has entered his eighth decade with every prospect of many years of active work.

Von Kupffer has devoted forty-five years to his researches. And these he has embodied in upwards of fifty memoirs. The number seems relatively small—the bibliography of von Baer is six times as great—but this is explained by the fact that the papers are mainly of a critical character and are the fruit of intricate and time-consuming studies, just as von Baer's '*Entwicklungsgeschichte der Thiere*' was the outcome of no less than nine years' of assiduous labor.

The writings of von Kupffer deal in the main with problems in special fields of embryology. A number of his well-known papers are contributions to histology, and there are several dealing with craniology, including the memoirs on the skull of his illustrious predecessor in Königsberg, Immanuel Kant.

The histological work of von Kupffer extends over a wide range of subjects. To cytologists he is known as a pioneer in the study of the ultimate nature of protoplasm. Thus, according to Bütschli, he ranks as the first to demonstrate satisfactorily the reticulo-vesicular character of protoplasm in living tissue. His observations in 1870 in the follicle cells of *Ascidia* showed distinctly the reticular meshwork and the breaking up of the cytoplasm into ultimate

'vesicles.' He also indicated for the first time (1870) the radial arrangement of the alveoli around the nucleus, together with the 'marginal alveolar layer.' The term 'paraplast' used by von Kupffer in 1875, is still in use (as the equivalent of what at present is more often known as 'metaplast') although in a somewhat different sense than that in which it was first used. His sustained interest in this theme was lately shown in his inaugural address (1896) as rector of the University of Munich.

The processes of the fertilization of the egg have been described by him in several forms. In an early paper on this subject he expressed his belief that in large meroblastic eggs a process of physiological polyspermy occurs, a view which his student, Professor Rückert, and other investigators have since confirmed and extended. His studies on fertilization have thus been important as leading the way for other papers from his laboratory—such for example as those on the fertilization of the lamprey and of the teleost by his devoted friend, Dr. A. A. Böhm, and also the earlier work of Theodor Boveri.

Von Kupffer's work should next be noted in connection with the structure of glands. In his studies on the histology of the liver he proved the presence of the secreting vacuoles in the gland cells and of the intralobular fibrous sheath. He next discovered the remarkable Sternzellen (or 'Kupffer's cells') in the wall of the portal capillaries: these he showed were not nervous, as was at first believed, but highly modified endothelial cells, and later he demonstrated their function as phagocytes. His researches on the development of the mammalian kidney should here be mentioned: these he carried on by means of serial sections cut by free hand—this was long before the time when section cutting became general—and by this means he was able to demonstrate more satisfactorily than

had hitherto been done the early separation of the mesonephric from the metanephric kidney, and he first showed the essential relations of the permanent kidney and its ureter to the mesonephric duct.

Another of his histological works deals with the structure of the stomach, in this in a measure preparing a way for the exhaustive comparative studies of his student, Professor Oppel. Other contributions relate to the development of the liver, spleen and pancreas (in *Ammocoetes*) and afford striking evidence that these organs are closely related genetically. Further papers discuss the characters of muscle cells, and the origin of blood in the valves in the dorsal vessel of the leech (*Rhynchobdella*). In his earlier work he was also attracted into the puzzling field of the electric organs in fishes (*Gymnotus*, *Mormyrus* and *Malapterurus*).

Another and perhaps the most important line of his histological work relates to the structure of nerves. He thus demonstrated that the axis cylinder was not a solid structure in the sense of the earlier investigators. This condition he showed was artifact: the 'cylinder' is rather to be looked upon as an axial canal containing in its fluid contents the delicate fibrils. In the matter of the central origin of nerve fibers his further observations have yielded a basis of the new neurone theory. The difficult question as to the exact mode of termination of nerve cells in an end-organ he also successfully answered in one of his earlier papers; in the salivary gland (*Blatta*) he was able to trace the final arborescence of the nerve filaments on the wall of the gland cell and he described the discoidal enlargement at the tip of each fibril.

Von Kupffer had never played the rôle of a pioneer in any extended field of embryological research. He has done the work—which has only too often the greater value—of extending, correcting and inter-

preting the results of earlier observers. Thus his famous work on the development of the Ascidian was in the path which had been opened by Kowalewsky, whose results, as von Kupffer himself notes, were then almost universally discredited. Von Kupffer soon came to support the new cause and he even outdid Kowalewsky himself in advocating the closer affinities of the ascidians and chordates. He thus showed in the ascidian the continuity of the cord and brain, the 'segmentation' of the tail, the presence of 'spinal nerves,' and the distinctly chordate character of the notochord, together, later, with interesting homologies in the sense organs. And so too in his extended paper on the development of the Lamprey he took up the unfinished work, and succeeded in reconciling several discrepancies in the results of Max. Schultze and Shipley. But it should be understood that the results of pioneer investigators were to von Kupffer but as the foundation stones of detailed and original work. Thus in his paper on the lamprey he soon laid aside his purely critical studies and attacked a series of difficult problems relating to the origin of the mouth, the cranial nerves, and of the primitive conditions of the central nervous system.

Gastrulation is one of the most difficult processes with which the student of the development of vertebrates has to deal. And it is upon this theme that the work of von Kupffer has thrown no little light. It was formerly thought—and this was the rock which wrecked the results of Pander, Baer, and Rathke—that in the large yolk-filled eggs of such animals as reptiles and birds the germ-layers of the embryo arise one from the other by a process of splitting (delamination). Von Kupffer, however, was able to demonstrate that in these forms a process of infolding occurs, modified, it is true, but proving that the gastrulation of the higher forms is clearly homologous with that of the amphibia and many fishes.

He was also the first to give a satisfactory interpretation to a characteristic structure of the gastrulation of the meroblastic types, the primitive streak. An especially remarkable feature of von Kupffer's work was that he made his interpretation of the invaginate character of the early gastrula of a meroblastic type in his study of the teleost—a form in which the appearance of the infolding process is so difficult to observe that his early results were for thirty years discredited—and it is only recently that the 'prostoma' in these forms is again described (Sumner). It was his earliest paper on teleostean development, by the way (Ref. No. 6, II.), which describes 'Kupffer's vesicle,' which in the matters of its homology and function has since been an unusually fruitful theme for controversy. We may note in passing that von Kupffer believed that the region of the prostoma was (as he also interpreted the primitive streak of amniotes) the *only* region of gastrulation in the bony-fish, that he failed to determine the invaginate character of the germ ring, and that he interpreted the early embryo as equivalent to the primitive streak, and not therefore to the actual embryo.

In connection with Kupffer's work on the development of the teleosts it should be mentioned that it is he who deserves the credit for the view that the cells of the blastoderm are the progenitors of the periblast nuclei, and that they also give rise to the tissue cells of the embryo, questions of great theoretical importance. His work on the development of the herring, undertaken in the interest of the Commission for the Investigation of the Fisheries of the German Ocean, is a further memorable contribution to the biology of fishes. Here for the first time in any extended embryological memoir photo-micrographs were introduced as plates.

Only a tithe of von Kupffer's publications relate to the development of mammals.

His most noteworthy paper deals with the question of the 'inversion of the germ layers' which had been described in a rodents, a condition which appeared to be an extraordinary contradiction to the usual mode of origin of the germ layers. By means of a series of stages of the field-mouse he showed conclusively, however, that this 'inversion' was only apparent: during early growth the embryonic area bowed downward to the ventral side of the ovum, so that the flattened gut came to be apposed to the surface while the central nervous system was left to develop within the cavity of the ovum.

The philosophy of the vertebrate head has furnished the fruitful theme of von Kupffer's studies during the past ten years. And his memoirs (three of the series have thus far appeared) upon this subject are, I think, regarded generally as his *magnum opus*. His endeavor in these memoirs is to demonstrate by ontogenetic conditions in the lowest craniotes the mode of origin, phylogenetic, of the structures of the vertebrate head—brain, cranial nerves, sense organs, mouth region, muscles and skeleton. The plan of this series accordingly recalls somewhat that of Dohrn in his 'Urgeschichte der Wirbeltiere,' although the views of their authors are usually widely at variance. Von Kupffer derives the ground plan of the conditions of the vertebrate head from that in the protochordates while Dohrn, for a long time, at least, has been the strong supporter of the famous annelid theory. Certain it is that the results of von Kupffer are welcomed by the warmest interest even by those whose faith in the great value of developmental characters as tests of phylogeny has been severely shaken. And all will admit he has already been able to clear up a number of doubtful points in cranial problems: thus, to mention but an instance or two of the general value of his work, it is now

found possible to determine definitely the most anterior point of the brain and to compare with certainty—thanks to his revision of topography—such widely distinct and important regions as those of the lobus olfactorius impar, the recessus opticus and the tuberculum posterius, in all chordates from amphioxus to man. So, too, his determination of the metameral characters and subdivisions of the cranial nerves bids fair to become a classic if not an epoch-making contribution to the philosophical side of this long investigated and difficult subject.

In a late number of the *Münchener Medicinische Wochenschrift*, Professor Rückert\* pays a tribute to von Kupffer's remarkable power of continuing and improving the quality of his work in spite of the burden of seventy years, and he concludes his paper with the wish that von Kupffer will long be spared to continue his good work. In this wish his American colleagues heartily join.

BASHFORD DEAN.

The following bibliography of von Kupffer is largely due to the kindness of my friend, Dr. L. Neumeyer, of the Anatomical Institute in Munich.

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\* To Professor Rückert's interesting paper I am indebted for a number of the present notes.

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#### RECENT PROGRESS IN GEODESY.\*

THIS report is not based upon a complete examination of the recent literature of geodesy. The writer has been too busy to devote much time to the special research necessary to justify any claim to completeness. His regular duties have, however, kept him in touch with recent operations in geodesy, much more closely in touch, however, with operations in the United States than with those of Europe. The sketches of recent progress in each of several sciences called for by the rules of the Society are, as I conceive, to be written primarily, not for those well versed in that particular

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